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# APPLICATIONS OF LEAN TOOLS IN COCONUT OIL MANUFACTURING COMPANY AT ERODE DISTRICT

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***ABSTRACT***

***In recent years, there are many factors that influence the productivity in manufacturing organization. The most widely tackled issue is how to improve efficiency and productivity. Time study technique is one amongst the productivity improvement techniques employed in several producing firms. Time study is defined as a scientific analysis method designed to determine the best way to execute the repetitive task and to measure the time spent by an average worker to complete a given task in a fixed workplace.***

***This study shows Warehouse Management System (WMS) practices and their effects on operations. WMS was found that it has a positive impact on companies' performance on operations management measures. Companies that manage warehousing of their products are expected to implement WMS in order to maintain their competitive edge in the global market place.***

***KEYWORDS: Lean, Warehouse, Wastes, Coconut Oil, Production, Time Study & Copra***

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Original Article

## 1. INTRODUCTION

From "lean thinking" to "lean enterprise" and "lean manufacturing," the word has created many catchphrases. But what does it mean to be "lean"? It entails shedding waste in order to reduce costs and increase competitiveness.

The principles of lean production, or Lean Manufacturing (LM), were developed in the 1960s by Toyota as an evolution of the concept of integrated production and structuring of production practices that were adopted in Toyota plants. These principles are associated with the search for overcoming the seven basic types of waste identified as chronic by the Toyota Production System: waiting, overproduction, transportation, defects, inventory, handling and unnecessary processing.

The two most popular process improvement methodologies in use today, lean manufacturing and Six Sigma, originated at Toyota and Motorola, respectively. These pioneering companies are discrete manufacturers.

The application of lean approach only in manufacturing processes would restrict the achievement of its potential benefits, as the constant search for waste disposal has become role not only in manufacturing, becoming a responsibility for several areas of the organization, mainly to product design, since its result directly impacts the

production process and product performance and process.

### 1.1 Coconut Oil Manufacturing – Market Potential

Coconut oil is used in the manufacture of toilet soaps, laundry soaps, surface active agents and detergents, hair tonics, hair oil, massage oil, cosmetics, etc. Growing in tropical locations coconut has the global market opportunity.

The main consumer of coconut products, particularly coconut oil and copra, remains to be the United States. In the European Union member countries, the Netherlands serves as a main port for the importation of these products, which are then distributed to other countries. Refined coconut oil enjoys high demand in France and Germany, with its diverse applications in the cosmetics industry. Thus, we can say, coconut oil manufacturing is a profitable business opportunity for the new entrepreneurs.

### 1.2 Demand for Coconut Oil

The demand for coconuts has skyrocketed in the last few years. Coconut everything can be found in the natural food market. Coconut oil, coconut sugar, coconut water. Not to mention just plain old coconuts. At the same time, coconut producers are having a hard time keeping up. Supply on coconuts has also gone down slowly over time, which as a matter of simple economics has driven prices up.

## 2. REVIEW OF LITERATURE

**Au Yong HuiNee (2015),** They analyses the relationship between adoption of WMS to its impacts on business performance and competitive advantage of a regional distribution centre.

**Mihir B Patel, Prof. Dr. Hemant R. Thakkar, Mr. Rajput Santosh(2015),** this study performs a work study analysis at the audio division of with the aim to offer suggestions to improve its operational and production efficiency.

**Rui Borges Lopes, Filipa Freitas and Inês Sousa (2015), t**his work presents the application of some LM tools, and the corresponding shift in philosophy, in two Portuguese companies of the food and beverage industries. Main implementation issues are presented and discussed followed by the results obtained from the application of LM tools in the production system of these companies. Significant gains are obtained in both companies and, more importantly, it stills a continuous improvement culture and increases production flexibility while reducing lead times.

**Natasa Vujica Herzog and Stefano Tonchia(2014),** the research survey carried out within 72 medium and large-sized Slovenian manufacturing companies. Eight crucial areas were identified based on a synthesis of ‘lean’ literature for assessing and measuring the degree of lean implementation within existing manufacturing systems.

**Deepak Kumar, Sumit Kumar Singh and Khemch and Sharma (2014),** the goal of this research is to investigate how lean manufacturing tools can be adapted from the discrete to the continuous manufacturing environment, and to evaluate their benefits on a specific application instance.

**Gaurav Kumar, Rajender Kumar and Gupta S. K (2013),** they investigate how to improve the productivity and in time delivery as expected by customers. A detailed study of production process and the total lead time for manufacturing the rim has been calculated and the result reveals that the present facilities for manufacturing rim is not being used as per their capabilities i. e. nearly half of the production capacity of the plant.

**Abdul Talib Bon and Aliza Ariffin (2012),** here researcher used Time and Motion technique to improve work process at SME, and the research objectives towards accomplished this study is to identify problems in the production work process and improved it in terms of production time, number of process and production layout by proposing an efficient work process to SME. The study uses systematic observation, process chart and stopwatch time study as research methodology.

**Ramaa. A, Subramanya K. N and Rangaswamy T. M (2012), t**he findings of the study carried out to evaluate performance levels and enhance productivity of the manual warehouses by developing a WMS framework and cost benefit analysis. The study was conducted at India's biggest retail company, which has developed expertise in Supply Chain Management of consumer product categories such as Fashion, Food and General Merchandise. Out of the three warehouses where the study was taken up, one had automated WMS and the other two warehouses were manually run.

**Khalil R. A, Stockton D. J, and Tourki T** (**2012), t**hey describe the work undertaken to implement lean practices in the continuous process sector as represented by cement production. One of the major barriers to lean implementation is providing evidence of its potential benefit to end-users. This work aims to overcome this obstacle by producing a tool which can be used to easily visualise the benefits of adopting lean practices without requiring disruption to the production environment.

**Rajenthirakumar. D, Sridhar. R, Dominic Savio. A, Jerine Chrispal. S and Srinath. N(2012),** this paper's implementation of lean philosophy in a textile machinery manufacturer, with a focus on elimination of process bottle necks and optimizing the layout process. Value stream mapping was the main tool used to identify the opportunities for various lean techniques. The primary motive is to evolve and test several strategies in the elimination of bottle necks on the shop floor by the incorporation of a layout modification and a versatile automation strategy.

**Abdul Talib Bon and Daiyanni Daim (2010)**, this method in order to increase production and identify any improvement that could be made through identifying the process that involving manpower as the main reason and state the time standard in order to achieve the objectives of increasing the production and decreasing the cost. They use systematic observation, interview with discussion and stopwatch time study. Statistically Fit and Production Modeller software is used here to test the data and make improvements. By stating the time standard for the process involving manpower, production rate increase and the cost will be less.

## 3. RESEARCH FRAMEWORK

### 3.1 Problem Identification

At present due to the unavailability of the fixed standard time, the organization faces problem by not knowing the time of completion of the process. And also to know about the manpower required for the work, the study is required. Thus, there is necessity for time study in the organization.

In the warehouse, the raw materials are stored in the production process. They are storing 500 MT of copra in warehouse there is no proper layout for stocking of copra which leads to violation of FIFO, difficulty for fumigation and go down aging tracking period. So warehouse management should be studied for construct the planning and for the better efficiency of the layout.

### 3.2 Objectives of the Study

- To determine the standard time required for the operations happening in the oil mill process.
- To maximize the warehouse storage utilization and implementing FIFO.
- To give suggestions to the organization for an effective work environment without bothersome and useless influences.

### 3.3 Methodology

#### 3.3.1 Time Study

Time study is a work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions and for analysing data so as to determine the time necessary for carrying out the job at a defined level of performance.

**Method for Calculation**

**Step 1:** First select the job to be studied. Break down the work content of the job into smallest possible elements. Then inform the worker and define the best method.

**Step 2:** Observe the time for the appropriate number of cycles (such as 25 to 50).

**Step 3:** Determine the average cycle time (CT)

$$\text{Average cycle time} = \frac{\text{Sum of cycle times recorded}}{\text{Number of cycles observed}}$$

**Step 4:** Determine the normal time (NT)

Normal time = Average cycle time x Performance Rating

**Step 5:** Determine the standard time using the following formula,

$$\text{Standard time} = \frac{\text{Normal time}}{\text{Allowance factor}}$$

$$\text{Allowance factor} = \frac{1}{1 - \%\ \text{Allowance}}$$

#### 3.3.2 Warehouse Management System

Warehouse management is an integral part of a company's business strategy. Efficient warehouse management can ensure that a company ships and receives vital stock in time for replenishment on store shelves or in manufacturing facilities.

**Guidelines for Warehouse Planning**

- Fumigation of godown to be done as per the defined frequency. Only Food grade fumigant to be used. The pest control certificate should be available with Godown.
- Stacking of the copra bags should be done in a systematic manner so as to have,
    - Traceability of the material – to ensure FIFO system
    - Safe while handling
- Storing period of copra in the godown is maximum 3 months (90 Days).
- Copra bags are not to be kept directly on the floor, Pallets should be used.
- All the lots should be analyzed for inferiors & quality parameters (as per specs). Specs Criteria for storing Copra in the godown is as follows
    - Moisture should not more than 5%
    - Green copra should not be more than 1.5%.
    - Only Grade – 1 copra to be stored.
    - In case the above conditions are not met, the copra storage should be for maximum 30 days instead of 90 days.
- After taking the load back from the godown, the inferiors & quality parameters should be analyzed. The lot should have all the q-parameters within specification.
- If the lot fails, and the same needs to be consumed, it can only be taken under the waiver.
- Grade 2, 3& 4 type of copra not be used for storage.

## 4. ANALYSIS AND INTERPRETATION

### 4.1 Time Study in Oil Filtration Process

Oil filtration is the process which filters the copra from oil. There involves several functions. Operations involved in Oil Filtration

- Charging
- Recirculation
- Filtration
- Drying

In oil filtration area, I have observed the data's for seven days. I have learnt about the overall process happening in the filtration process.

**Observation**

The time taken for completing one cycle is shown below:

**Table 4.1: Oil Filtration Process**

| Activity | From | To |
|---|---|---|
| **Charging** | **10.15 AM** | **10.20 AM** |
| **Recirculation** | **10.20 AM** | |
| Idle | 10.25 AM | 10.45 AM |
| Adjustment | 10.45 AM | 10.50 AM |
| Idle | 10.50 AM | 11.05 AM |
| Adjustment | 11.05 AM | 11.12 AM |
| Idle | 11.12 AM | 11.18 AM |
| Recirculation | | **11.20 AM** |
| **Filtration** | **11.20 AM** | |
| Idle | 11.25 AM | 11.35 AM |
| Adjustment | 11.35 AM | 11.40 AM |
| Idle | 11.42 AM | 12.10 PM |
| Filtration | | **12.30 PM** |
| **Drying** | **12.30 PM** | |
| Idle | 12.35 PM | 12.50 PM |
| Drying | | **1.00 PM** |

**Calculation**

For Charging

$$\text{Average cycle time (CT)} = \frac{\text{Sum of cycle times recorded}}{\text{Number of cycles observed}}$$

= 5.6 mins

Performance Rating = 100 %

Normal time (NT) = CT * PR

= 5.6 * 100 %

= 5.6mins

$$\text{Allowance factor(AF)} = \frac{1}{1 - \%\ \text{Allowance}} = \frac{1}{1-(10/100)}$$

= 1.11 mins

Standard time(ST) = NT * AF

= 5.6 * 1.11

***Standard time for Charging = 6.216 mins***

**For Recirculation,**

$$CT = \frac{49+48+49+46+48+51+53+57+55+49}{10}$$

CT = 50.5 mins

NT = CT * PR

= 50.5 * 100%

= 50.5 mins

ST = NT * AF

= 50.5 * 1.11

***Standard Time for Recirculation = 56.055 mins***

**For Filtration,**

$$CT = \frac{46+39+40+38+50+41+46+39+38+41}{10}$$

CT = 42 mins

NT = CT * PR

= 42 * 100 %

= 42 mins

ST = NT * AF

= 42 * 1.11

***Standard Time for Recirculation = 46.62 mins***

**For Drying,**

$$CT = \frac{41+39+36+42+40+45+36+39+38+36}{10}$$

= 39.2 mins

NT = CT * PR

= 39.2 * 100 %

= 39.2 mins

ST = NT * AF

=39.2 * 1.11

*Standard Time for Recirculation = 43.512 mins*

We found that for completing one cycle of work it takes 153 mins **(Approx 2.30 hrs).** Here in 2.30 hours of work, the labor was idle for around 1.50 hours

### 4.2 Time Study in Cake Bagging Area

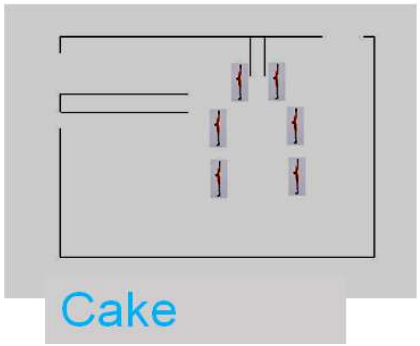


**Figure 4.1**

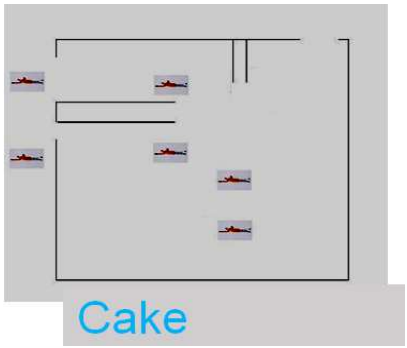


**Figure 4.2**

In cake bagging area, there are 6 to 7 labors that are used for packing and dispatching. Through conveyor cake will reach the bagging area. There are 2 labors used for holding the bags and 4 labors for shifting the bags to store in the room and all these men were involved in the stitching the bags. After stitching is completed, the bags will be dispatched to the truck through another conveyor.

I have been in the cake bagging room for three days and observed the process. In cake loading, 40 bags will be loaded approximately in 10 minutes time it will exclude power breakdowns. While dispatching if there is 6 labors at work, 2 men were used for loading the bags in truck and remaining four people were used for holding the bag and placing it in the conveyor. The truck will be loaded with the bags within 30 to 35 minutes.

**Operations Involved in Cake Dispatch**

- Cake loading in the bag
- Cake bag moved to a storage area
- Cake bag Stitching
- Cake dispatching to truck

Here to the maximum of 50 tons cake will be dispatched. If the stock is more, 7 men were used for the work. 35 tons of cake will be dispatched regularly. Cake bagging room can stock 500 bags of cake. The bag will contain 70 kg of cake. They will load 16.5 tons (i. e. 250 bags) in single truck. So they can load two trucks regularly.

**Man Power Involved in the Process**

- Cake loading in the bag *(2)
- Cake bag moved to storage area *(4)
- Cake bag Stitching (6)
- Cake dispatching to truck (6)

**Table 4.2: Manpower Required for Cake Bagging**

| Details | UoM | Values |
|---|---|---|
| Man Power | Nos | 6 |
| Working Time | Hrs. | 8 |
| Truck Capacity | Bags | 250 |
| # of Trucks | Nos | 2 |

***Standard Time for loading one bag = 18.01 seconds***

***Standard Time for stitching one bag = 34.07 seconds***

***Standard Time* for moving cake bag to storage area= *11.1 seconds***

**Table 4.3 Time Study (Loading & Stitching)**

| Activity | Average Time |
|---|---|
| loading in the bag | 16 sec |
| Cake bag Stitching | 30 sec |
| Cake bag moved to storage area | 10 sec |
| **Overall Time** | **1.1 min** |
| **250 bags ( Truck Capacity)** | **4 hrs. 35 min** |

*The overall time includes the idle time also

From the calculation, the standard time for cake bagging, stitching and cake bag moving to storage area are found. The overall time taken completing one bag is 1.1 minutes. They have to load 250 bags for one truck in a period of time. The time taken for completing 250 bags is 4 hours 35 minutes

**For Cake Dispatching**

In this process, the cake bag stored in the storage area is moved by the labors to the truck. Here the truck will carry 250 bags of cake for a single load. The activities carried in cake dispatching are:

- Taking the bag to conveyor
- Lifting the bag from conveyor and
- Unloading the Bag from the conveyor to Truck

***Standard time for cake bag dispatching = 7.3 seconds***

Here for dispatching one cake bag it takes 7.3 seconds. For 250 bags it takes 30 minutes for completing the process

**Table 4.4: Time Study for Overall Process**

| Current Method (Truck) | Time(for 250 bags) |
|---|---|
| loading, Stitching | 4 hrs. 35 mins. |
| Dispatching | 30 |
| **Total** | **Approx. 5 hrs.** |

For loading and stitching 250 bags it takes 4 hours 35 minutes) and for dispatching it takes 30 minutes. Totally for completing the overall process it takes 5 hours for 250 bags.

### 4.3 Warehouse Management Process

A warehouse management system (WMS) is a application that supports the day-to-day operations in a warehouse. WMS programs enable centralized management of tasks such as tracking inventory levels and stock locations.

**Current Method**

The godown is controlled by RMHS (Raw Material Holding and Storing) department. In Coconut Oil Manufacturing, regularly 120 tons of copra is loaded for the production. So the company needed 120 tons of copra. In daily basis, 12 trucks are utilized for stocking the copra. Each truck carries 10 tons of copra (i. e. in each truck, there will be 200 bags). Each bag carries 50 kg of copra. From RMHS, the truck will be unloaded and the copra will be sent into the conveyor for the production purpose.

There are four kinds of varieties in copra. Each variety will vary according its quality. Only grade 1 copra was used for the stock. Grade 2, 3& 4 type of copra is not used for storage. The stocks are kept in the godown to the maximum of 45 days. In godown, Coconut Oil Manufacturing have drafted the SOP. SOP (Standard Operating Procedure) is the standard procedure which gives information about the process that need to be used. The guidelines followed by SOP in godown are:

**Current layout**

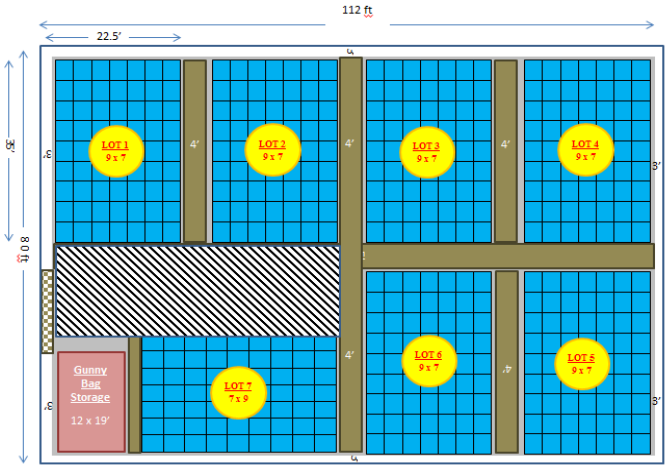


**Figure 4.3: Current Warehouse Layout**

The above layout is the current structure followed in godown by Coconut Oil Manufacturing. There are 9 lots in the godown. Each lot will carries 36 pallets. In each lot, 50 tons of copra is kept as stock. There are several difficulties faced while loading and unloading in the inventory.

**Constraints**

- Violation in FIFO
- Improper stocking
- Difficult for stock taking and stock releasing

- Difficult in fumigation
- No proper layout
- Difficult in aging tracking
- No better visual system

**Proposed Method**

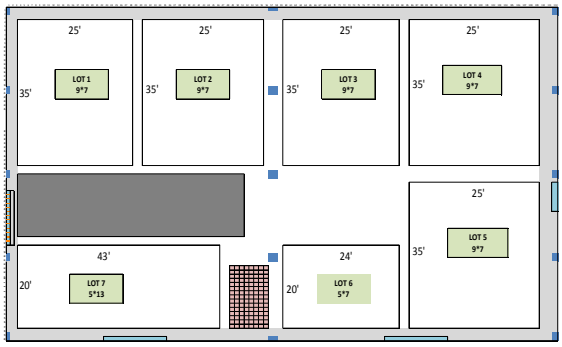


**Figure 4.4**

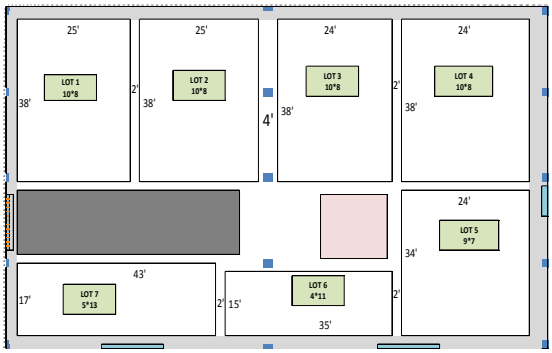


**Figure 4.5**

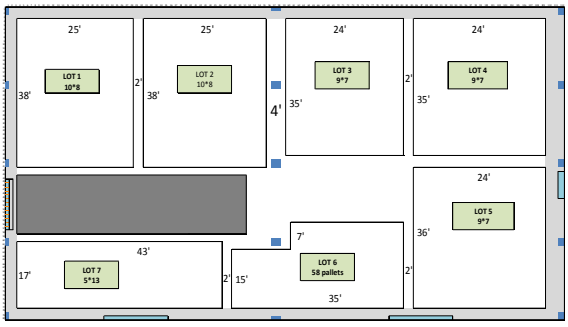


**Figure 4.6**

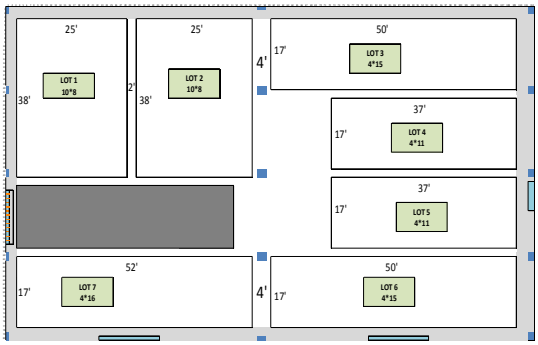


**Figure 4.7**

Figure 4.4 shows that there can be 415 pallets placed, which means 500 MT can be stored in the warehouse. Here FIFO can be maintained and gunny bags can be stored in a separate area.

Figure 4.5 shows that there can be 492 pallets placed, which means 590 MT can be stored in the warehouse. Here FIFO can be maintained and more space will be utilized.

Figure 4.6 shows that there can be 472 pallets placed, which means 567 MT can be stored in the warehouse. Here FIFO can be maintained.

Figure 4.7 shows that there can be 432 pallets placed, which means 518 MT can be stored in the warehouse. Here FIFO can be maintained and better visualisation can be provided.

## 5. FINDINGS, SUGGESTIONS, CONCLUSIONS

- From the time study made at oil filtration area, I found that for completing one cycle of filtration it takes 2 hours 30 minutes. All the works are carried in the machine. Manpower is required for the adjustments only. In 2 hours 30 minutes, the employee is working for 55 minutes only. It doesn't mean he is not working, their presence is

required only for 55 minutes. They are not idle while they were free, they were doing some other works related to the company only.

- From the time study made at cake bagging area, I found that for completing one bag they take 1.1 minutes ( i. e. for 250 bags it takes 4 hours 35 minutes). There are six employees assigned to do that work. For dispatching 250 bags they takes 30 minutes. So for the overall process they took 5 hours. In this five hours. When I observed about their idle time, they were idle for 26 seconds for completing one bag (i. e. for 250 bags it is around 2 hours). They are using two conveyors, one is for cake loading and one is for cake dispatching.
- In the warehouse, I found that lot of changes should be made. There are lot of things need to be sort out. The current method they are following are good for storing stock, but there are lot of confusions in FIFO. They can't follow FIFO with the current layout. There is difficulty in fumigation and maintaining the standard. The employees are not tracking the internal stock and aging. The study is to be made and the layout should be modified for the effective utilization.

**Suggestions**

- In oil filtration area, the standard time is fixed using the time study

  For charging - 5-10 mins

  For recirculation - 40-45 mins

  For filtration - 30-45 mins

  For drying - 30-40 mins

  and totally it takes *2 hours 30 minutes* for completion. Here one employee is utilized for doing the filtration process. The employee is idle for around 75% of the work time. The manpower required is little, so only employee is idle. At one time, only one filtration machine can be used, it is because the production is made only for that machine at that time. When production is increased, one more filtration machine can be used. If we use one more machine, the employee can't be idle for this much time. If company can't increase the production, they can utilize the employee for other company works.

- In cake bagging area, the standard time is fixed using the time study

  For loading one bag - 18 seconds

  For stitching one bag - 34 seconds

  For moving one bag to

  Storage area - 11 seconds

  and totally it takes 63 seconds for completing one bag. For 250 bags it takes 4hours 35 minutes. Here there are several gaps in the process. There are two conveyors, one for loading the cake and one for dispatching. If we introduce one more conveyor, the idle time can be reduced and we can do more bags in one day.

  For dispatching one bag - 7 seconds

For 250 bags it takes 30 minutes for dispatching. Overall the total time for 250 bag is *5 hours.* If we reduce the idle time, the work can be completed within 3 hours. So, we can able to do 2 trucks/day within the shift (8 Hrs.)

- In the warehouse, they're required, several modifications to be made. The current layout may stock more, but there is a violation in the FIFO. With the current layout, they can store up to 650 MT of copra in the warehouse. They started following this current layout one month ago. But I found there is a problem with FIFO. In warehouse, the company follows some standard operating procedure. The layout should be within the SOP. The current layout follows SOP, but fails to follow FIFO. I suggest Figure 4.6 for the warehouse. It might be less in storage, but this layout helps to follow FIFO and by regular observation the improper stocking can be reduced. If we use this layout, the stock retrieval will be easier. Better fumigation can be made. Better visual system can be created with this layout. The proposed layout can store 600 MT of copra, which is 50 MT less than the current layout. But with this layout, the company can use the warehouse effectively.

## CONCLUSIONS

The present study is used to analyse the applications of lean tools in Coconut Oil Manufacturing Limited. The different tools like time study, 5S and warehouse management system were used for analysing the data. From the time study, the standard time has been fixed. So, it helps the organization to know how much time the employee is working and their idle time. To sum up the implementation of the warehouse management system is a critical issue for the company. The study would work on the need of the WMS and what features should be included in the new WMS. A new layout is proposed for the maximum utilization of warehouse through warehouse management process. This project would also evaluate the deficiencies of the old system and will give recommendations for the new WMS.

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